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Effect of Different Osmopriming Sources and Levels on Germination and Root Length of Sorghum

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Abstract:

A laboratory experiment was conducted to evaluate the response of sorghum germination to various sources and levels of osmopriming. The experiment was laid down in completely randomize design with four replications. In this research eight priming sources i.e. NaCl, $CaCl_2$, KCl, KNO_3, NH_4Cl, Na_2SO_4, PEG and Manitol along with seed soaking in water and control were tested on sorghum seed germinated in laboratory to test germination % and the effect of osmopriming on germination of sorghum seed in incubator at room temperature after 24 hour priming. The data was recorded on germination % in incubator and at room temperature and root length (cm). Statistical analysis of the data revealed that germination % and root length were significantly affected by osmopriming sources and levels. Mean values showed that maximum germination (94 %) for PEG 8000, root length (7.02 cm) for NaCl. Among chemicals $CaCl_2$ showed higher germination. Similarly NaCl and PEG 800 were also better than other chemical sources. KNO_3 showed very poor performance among all chemicals. The lower levels of most chemicals

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performed better than higher levels. It was concluded that soaking seed with osmopriming agents in low concentrations enhances germination and rapid seed emergence.

Key words: osmopriming sources, level of germination, root length, Sorghum

1. Introduction

Sorghum (*Sorghum biclor L.*) Is an important food and forage crop of arid semi arid regions of the world. It is grown as food crop in Africa, Central America, South East Asia and China. On global basis it ranks fifth among cereals after wheat, maize, rice and barley. Sorghum contains 6.84 % protein, 1.5 % fats, 6.75 % ash, and 53.1 % nitrogen free extract.

In semi arid tropics, crops, often fail to establish quickly and uniformly, leading to decreased yields because of low plant populations. Constraints to good establishment include poor seed bed preparation [1], low quality seed, lack of soil moisture [2], high temperature. Resource-poor farmers often lack the means to optimize seedbed conditions before sowing and they are particularly at risk from adverse weather after sowing. On the other hand, good establishment increases comparativeness against weeds, increases tolerance to dry spells, maximizes yields and avoids the costly and time consuming need for re-sowing [3]. On-farm seed priming can leads to better establishment in tropical crops such as maize, sorghum, rice and chickpea [4].

Seed priming or osmoconditioning is a pre-sowing, controlled hydration treatment in which seeds are exposed to a water potential sufficiently low to permit pre-germinative metabolic activity without protrusion of the radical through the seed coat [5]. Although primed batches of seeds generally germinate more rapidly and uniformly than untreated batches, a major constraint on application of the technique is the occasional germination of seeds during the prolonged treatment period as a result of high imbibition rates [6]. Reports have indicated such germination at osmotic potentials of – 0.5 bar [7] and as promptly as 96 hour after initial treatment [8]. Optimum enhancement of primed seeds would occur just below the osmotic potential threshold for their germination [9], with enhancement at or above this threshold causing premature radicle protrusion, while Mauromicale and Cavallaro suggested a cultivar dependent response [10].

The osmotic potential of the priming solution influences premature germination through its effect on water uptake by the seed [11], as does the priming temperature [12]. Many researchers have taken this as evidence that the germination of seeds during priming depends not only on imbibition rate [13] but also on genotype [14]. The exact relationship between genotype, priming treatment and other inputs, on the one hand, and imbibition during and after conditioning, on the other hand, is thus worth of further investigation. The emergence and establishment of rain fed sorghum may not always be completely successful since, after imbibitions, any water shortage delays emergence, exposing the seeds to stress [15]. Therefore, there has recently been interest in the use of pre-sowing seed treatments involving full or partial hydration of seeds, which may improve emergence and subsequent establishment. Such treatments include the soaking of seeds in high osmotic potential solutions including organic salt [16]. Temperature, which is an important variable in such treatments, has both qualitative and quantitative effects on subsequent germination rates of treated seeds. Therefore the objectives of the current research were to study the effect of osmopriming on germination and emergence of sorghum and to find out yield due to osmopriming under field conditions.

2. Materials and Methods

Response of sorghum to various sources and levels of osmopriming was evaluated in completely randomize design with four replications in laboratory at University of Agriculture, Peshawar. Eight osmopriming sources each with two levels were used in experiment along with water soaked and control. The treatment used were T1=Control, T2= Hydro priming, T3= NaCl 150 mM, T4= NaCl 300 mM, T5=$CaCl_2$ 150mM T6=$CaCl_2$ 300mM, T7=KCl 150Mm, T8=KCl 300mM, T10=Na_2SO_4 150m T10=Na_2SO_4 M300mM, T11= NH_4Cl 150mM , T11= NH_4Cl , T13=KNO_3 150Mm T13=KNO_3 150Mm, T15= Manitol 2%, T15= Manitol 4 %, T17=PEG 100g lit^{-1} , T18= PEG 100g lit^{-1}. The effect of osmopriming on germination of sorghum seed was studied in incubator at 25^0C and at room temperature which was 32^0C. Seed was considered germinated when the radical length is >1 cm. After germination seedlings was then evaluated to determine the percentage of seeds that will produce a normal seedling, also damage seed and fungus attacked seed was counted. Thus, the germination percentage was reported as the maximum potential emergence for that seed lot if planted in nearly ideal conditions.

3. Results and Discussion

Germination % (Incubator)

Data on germination of in incubator is presented in figure 1. Statistical analysis of the data revealed that germination was significantly affected by osmopriming sources (OS), osmopriming levels (OL), control (C) Vs hydro priming (HP), chemical sources (CS) and interaction between CS x L, and HP Vs CS. Mean values showed that maximum germination (94 %) was recorded for PEG 8000 200 g L^{-1} followed by NaCl 150 *mM* (88 %) while minimum germination (23 %) was recorded for KNO_3. Hydro priming produced more germination (80 %)

compared with control (78 %). Control produced higher germination (78 %) than all chemicals except PEG 8000 (67.8%). Among chemicals KNO_3 produced lowest germination (23 %) as compared to any other chemical. Lower concentration of NaCl, $CaCl_2$, NH_4Cl, and KCl produced more germination than higher concentration while higher concentration of Na_2SO_4, KNO_3, Manitol and PEG 8000 resulted in higher yield than lower concentration. It is inferred from the data that sorghum germination was significantly affected by different sources and levels of osmopriming and their interaction. The difference in germination is due to the physical damage and toxic effect of some salts on seed radical and plumule. Priming solution influences germination by the effect of more water uptake by seed. These results are in agreements with Prakash and Pratapasman [11] who reported that soaking seed in chemical solution influences water uptake by seed.

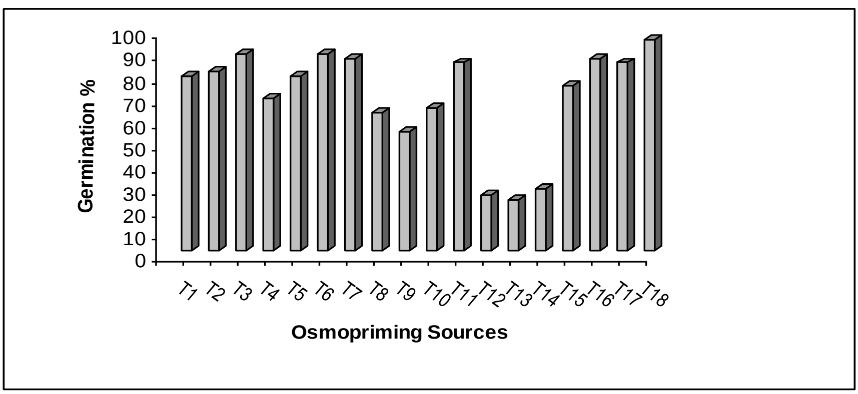

Figure 1. Germination % (Incubator) of sorghum as affected by different sources and levels of osmopriming.

Germination % (Laboratory)

Statistical analysis of the germination data in open laboratory at room revealed that germination was significantly affected by osmopriming sources (OS), osmopriming levels (OL), control (C) V s hydropriming (HP), chemical sources (CS) and interaction between CS x L, and HP Vs CS (figure 2). Levels of Potassium Nitrate and PEG 8000 were not significant. Mean values showed that maximum germination (84 %) was recorded for PEG 8000 followed by NaCl (80 %) while minimum germination (17.5 %) was recorded for KNO_3 fig 2.Hydropriming produced more germination (75 %) compared with control (72 %). Control produced higher germination (72 %) all chemicals (59.9 %). Among chemicals KNO_3 produced lowest germination (17 %) as compared to any other chemical.

Lower concentration of NaCl, $CaCl_2$, NH_4Cl, and KCl produced more germination than higher concentration while higher concentration of Na_2SO_4, KNO_3 Manitol and PEG 8000 resulted in higher yield than lower concentration. PEG 8000 150 mM produced more germination than other chemical sources and control. Same results were obtained by Arif and Tariq Jan [17] they reported that priming seed with PEG 8000 influences germination and greater seedling dry weight.

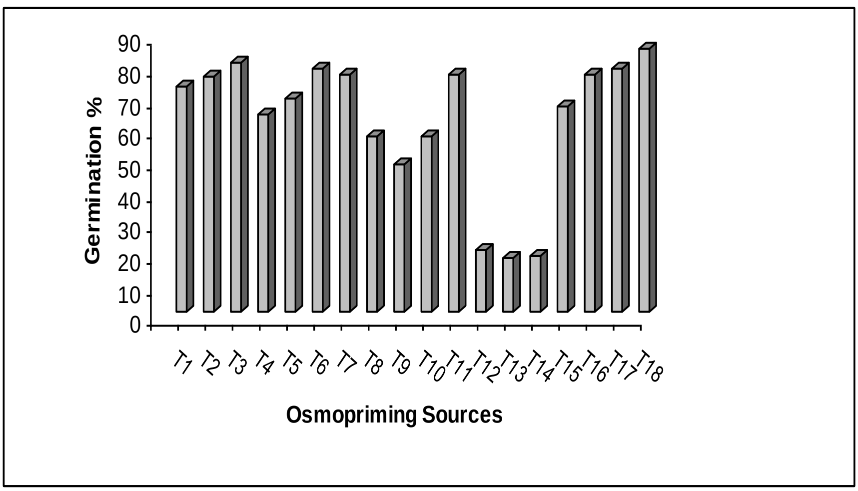

Figure 2. Germination % (Laboratory) of sorghum as affected by different sources and levels of osmopriming

Root length (cm)

Statistical analysis of the data revealed that root length was significantly affected by osmopriming sources(OS), osmopriming levels (OL), control (C) Vs hydropriming (HP), chemical sources (CS) and interaction between CS x L, and HP Vs CS (figure 3). Mean values showed that maximum root length (7.02 cm) was recorded for NaCl 150 mM followed by $Na_2SO_4$150mM (5.67 cm) while minimum root length (2.60 cm) was recorded for NH_4Cl followed by hydropriming (2.78 cm). Control produced more root length (5.13 cm) compared with chemical sources (4.5 cm). Hydropriming produced less root length (2.8 cm) than chemical sources (4.7cm).Lower concentration of all chemical sources produced more root length than higher concentration except Na_2SO_4 and KNO_3 fig 3. Basra *et al.* [18] reported the increase of radicle and plumule growth of primed onion seeds in 7 days after sowing and the primary seedling growth. It was observed that seeds number and performance of each plant in prime seeds of chickpea (water and mannitol 4%) was higher in comparison with nonprime seeds. This is the resultant of the increase of acid invertase activity in the apical of the main stem after sowing, because the availability of apical to hexsose, increased as the result of enzyme activity [19].

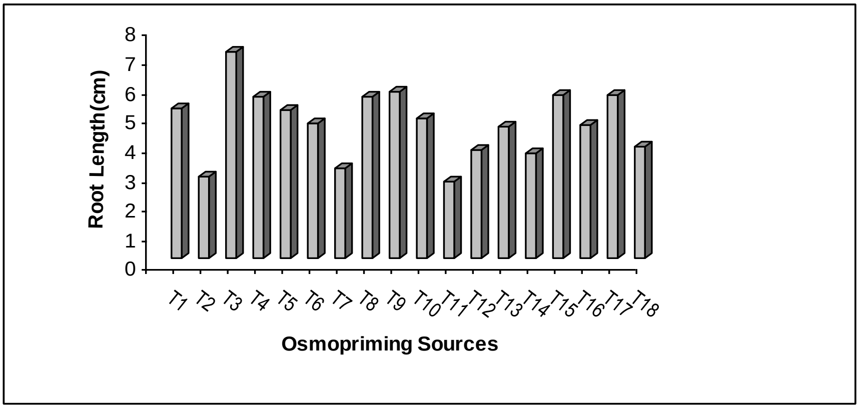

Figure 3: Root length of sorghum as affected by different sources and levels of osmopriming

Conclusions

Seed priming with osmopriming chemical produces more yield than control. Seed priming with $CaCl_2$ and NaCl performs better than other chemicals. Lower concentration of osmopriming is better than higher concentration

REFERENCES

Al-Mudaris, M. 1998. "Studies on osmotic conditioning seed treatments to enhance germination and early seedling growth of sorghum and pearl millet under drought, heat and combined stress conditions." *Ann. Bot.* 55: 229-233. [6]

Arif, M. and T. Jan. 2005. "Effect of seed priming on emergence, yield and stability of Soya bean." *NWFP Agri Uni Peshawar*. [17]

Basra, A. S., B. Singh and C. P. Malik. 1994. "Amelioration of the effects ageing in onion seed by osmotic priming and associated changes in oxidant metabolism." *Biol. Plantarum*. 36(3): 365-371. [18]

Bewley, J., and M. Black. 1978. *Physiology and biochemistry of seeds in relation to germination*. 2. Springer-Verlag, New York. [13]

Chun, Seong, R., C. Minor, and E. Hi Hong. 1986. "Effects of temperature, seed water content and osmoconditioning on germination and seedling elongation of soybeans." *Korean J. Crop Sci.* 3:447-453. [12]

Clark, L. J., W. R. Wally, J Ellis-Jones, K. Dent and C. Chiduza. 2001. "On farm seed priming of maize. A physiological evaluation." Eastern and Southern African Maize Conference." 268-273. [3]

Frett, J., and W. Pill. 1989. "Germination characteristics of somatically primed and stored Impatiens seeds." *Scientia Hort*. 40: 171-179. [7]

Gurmu, M. and R.E.L. Naylor. 1991. "Effects of low water participatory-paired plot comparison of primed and non-potential on germination of two sorghum cultivars. Seed primed maize seed in Zimuto and Mshagashe." *Science and Technology* 19: 373-383. [2]

Harris, D., A. Joshi, P.A. Khan, P. Gothkar, and P.S. Sodhi. 1999. "On-farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in India using participatory methods." *Exp. Agric.* 35: 15–29. [4]

Heydecker, W., and B. Gibbins. 1978. "The priming of seeds." *Acta Hortic.* 83: 213-215. [5]

Jett, L., G. Welbaum, and D. Morse. 1996. "Effects of matric and osmotic priming treatments on broccoli seed germination." *J. Am. Soc. Hort. Sci*. 121: 423—429. [9]

Jones, K., and D. Sanders. 1987. "The influence of soaking pepper seed in water or potassium salt solutions on germination at three temperatures." *J. Seed Technol*. 11: 97—102. [8]

Joshi, A., P. A. Khan, and P. Gothkar. 1988. "On farm seed priming in semi-arid agriculture. Development and Evaluation in Maize." *Crop Sci*. 35: 11-29. [1]

Kader, M. 2001. "Heat shock events, inhibition of seed germination and the role of growth regulators in stress alleviation." *J. R. Soc. NSW*. 134: 79—88. [15]

Kader, M. A. and S. C. Jutzi. 2002. "Temperature, osmotic pressure and seed treatments influence imbibition rates in sorghum seeds." *J. Agronomy & Crop Science*. 188: 286—290. [16]

Maiti, R., and L. Moreno. 1995. "Seed imbibition and drying as a technique in evaluating sorghum lines for adaptation to dry sowing in the semi-arid tropics." *Exp. Agric*. 3:57-63. [14]

Mauromicale, G., and V. Cavallaro. 1995. "Effects of seedosmopriming on germination of tomato at different water potential." *Seed Sci. Technol*. 23: 393-403. [10]

Prakash, L., and G. Prathapasenan. 1988. "Putrescine reduces NaCl-induced inhibition of germination and early seedling growth of rice (Oryza sativa L.)." *Aust. J. Plant Physiology*. 15: 761-767. [11]

Subedi, K. D. and B. L. Ma. 2005. "Seed priming dose not improve corn yield in a humid temperate environment." *Agron J.* 97: 211-218. [19]